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MATHEMATICS IN THE HORACE MANN SCHOOL FOR BOYS.

A teacher of English who is notoriously deficient in mathematical interest stopped me in the corridor one day and said, "What in time is X doing in his classes? Every time I pass his door those boys arouse my curiosity. For they are doing things that I never had when I went to school; things that look interesting!"

Well, what were those boys doing? Perhaps he caught a glimpse of some youthful "seventh graders" trailing a tape measure around the room, or squinting along a rod out of the window, or learning to use a pantograph. Or maybe he saw a class of ninth-grade boys being initiated into the mysteries of their fascinating new slide rules, anxiously comparing the setting of their rules with the setting on the huge slide rule hanging on the wall in front of them. Or perhaps he peeked in at times, only to find the room deserted. And then he remembered having seen the youngsters exuberantly leaving the building armed with stakes, tapes, and some funny-looking homemade instruments which I had to tell him we playfully called altazimuths to give them some standing in the community; or he had just passed the seniors on their way out to give the transit and level rod an airing.

What is it all about? Has X caught the project fever? Far from it. Ordinarily you will find him busy teaching the good old-fashioned mathematics, with the boys doing their full share of thinking, and of hard work without frills. But at the right time he can inject new interest into the work.

On what is this new interest built? Three fundamental aims: (1) To develop the curiosity of the boys who come to us; (2) to give them that knowledge and that appreciation of their surroundings which may be expected of cultured persons; and (3) to increase their ability to serve society. And that they may serve society more efficiently, we of the mathematics department hope that they will acquire not only the content of

certain particular subjects and the special technique pertaining thereto, but that they will also learn to think accurately, to work thoroughly, and to attack intelligently and successfully the problems which confront them.

Before proceeding to outline the course of study in mathematics which we use in attaining our aims, a word or two as to the organization of the school and of the department will not be amiss. The school is a six-year high school, in which in fact, though not in name, the first three years form a junior high school and the last three form a senior high school. The motive underlying this actual division of the school is our desire to differentiate the younger boys from the older boys. The junior school periods of 55 minutes, the consequent opportunity to train the boys in Grades VII., VIII., and IX. in proper habits of study, and the necessity of giving them shorter home-work assignments, all call for a treatment essentially different from that accorded the older boys, who meet in class for only 40 minutes and are expected to cover much longer assignments working by themselves.

Each teacher in the department of mathematics has classes in both the junior and senior high schools. He is fully acquainted with the aims and policy of the department and knows intimately what we collectively are trying to do in the upper and lower schools. The deeper understanding and broader vision which he is thus enabled to bring to each of his classes results in a coordination of all the different courses into one continuous whole.

The course of study in mathematics is as follows:

JUNIOR HIGH SCHOOL (REQUIRED).

Grade VII. Arithmetic and Intuitional Geometry.

1. Twelve weeks: Systematic treatment of fractions and decimals; percentage. Practical measurements; drawing to scale; the decimally divided foot.
2. Seventeen weeks: Intuitional geometry and mechanical drawing, with special attention to practical problems.
3. Five weeks: Introduction to ratio and proportion and to square root in connection with elementary surveying work.

Grade VIII. Algebra and Arithmetic.

1. First term: Solving problems involving the formula, the equation, simple algebraic operations, negative numbers, and graphs.

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2. Second term: Applications of algebraic methods to the solution of problems in arithmetic, with special emphasis upon those problems in percentage, interest, and mensuration which arise in the home, the office, and the school.

Grade IX. Algebra and Computation.

1. Special products and factors. Fractions and fractional equations. Simultaneous equations. Introduction to the laws of exponents, to radicals, and to numerical quadratic equations. Much emphasis laid on the solution of graded problems.
2. Extended course in computation by means of logarithms, slide rule, tables, graphs. Application to advanced arithmetic, to the mensuration of plane and solid figures, and to numerical trigonometry. Approximations and checks.

SENIOR HIGH SCHOOL (ELECTIVE).

Grade X. Algebra and Geometry.

1. The laws of exponents; radicals. Quadratic equations. Simultaneous equations. Progressions. Binominal theorem. Proportion, variation; literal equations; equations of any degree. Review of algebra, including abstract problems.
2. Plane geometry. *Book I.* and review; original exercises. Part of *Book II.*

Grade XI. Geometry.

Plane geometry, *Books II.-V.* Intuitional solid geometry Review of plane geometry. Many original exercises throughout the course.

Grade XII. Geometry; Trigonometry; College Algebra.

1. First term. Solid geometry.
2. Second term. Plane trigonometry. Use of the transit.
3. Second term. College algebra. Elementary notions of the calculus. Slope of a curve; rate of change of a variable; the derivative. Differentiation of the simplest algebraic functions. Applications to geometry and physics.

Each course meets five times a week.

Paralleling the last four years of this course of study is a second course of study in which algebra and then plane geometry are completed in turn, a year and a half being devoted to each subject. Following these comes the work of the senior year in solid geometry, trigonometry, and college algebra as outlined above. This second course of study serves two purposes: it accommodates in one set of sections those boys who have completed elsewhere the eight grades of the elementary school and wish to enter our ninth grade; and it makes possible the formation of other special sections for groups of boys

whose rate of progress should differ from that of the majority.

The following are some of the considerations which led us to adopt the course of study as given above for the six-year high school. Since abstract reasoning comes with maturity, such subjects as literal equations, the theory of exponents, and most of the abstract problems of algebra have been placed as late in the course of study as practicable. For a similar reason, demonstrative geometry, treated as a course in formal logic and in precision of statement, is begun in the middle of Grade X. Moreover, we devote a year and a half to plane geometry. As a result of this only a very few boys fail to pass in it; and, in addition, since there is ample time to do many original propositions, properly graded in difficulty, most of the students acquire a habit of straight thinking and of clear and accurate statement which will stand them in good stead in other fields and which only a few would be able to acquire if the subject were completed in a year.

As outlined, perhaps this course of study seems as dull as any other, but—

In Grade VII. we are confronted each year in September with a group of new boys from different schools. A barren review of the fundamental operations, in which they are not uniformly skilled, would be uninspiring to teacher and pupil. To obviate this we start with mensurational work, indoors and outdoors; and then through problems which arise from this work we effect a review of the fundamental operations. From the very beginning the pupils are introduced to the general notion of significant figures. Following this comes percentage, which with its numerous applications occupies the boys' attention until Christmas.

The first four months of the new year are devoted to intuitional geometry, with elementary mechanical drawing. After which the remaining months in the spring are given over to elementary surveying work done outdoors in connection with the subjects of proportion and square root. In this course the boys learn how to measure lengths and angles, directly and indirectly, and how to construct and use a simple altazimuth.

Again, the second term of Grade IX. has seemed to us a fitting place to give a course in the use of logarithm tables, the

slide rule, other devices for rapid computation such as adjacent scales and alignment charts, with many applications to advanced arithmetic. Compound interest and present value, statistics, variation and proportion, and mensuration offer a wide field in which to exercise these new aids to calculation. The question of significant figures colors the work throughout. Still further practice is derived from numerous problems in numerical trigonometry, including the logarithmic solution of oblique triangles.

The curiosity which caused the English teacher to pause outside the door is of course much stronger with the boys in class, who are led over the necessary drudgery inherent in the best mathematics teaching by the impetus which these high points of practical interest impart.

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